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(54) Title: HOLLOW-NEEDLE DEVICES

(57) Abstract: Hollow-needle device (100) comprises a hollow plunger (105), a body part affording a cylindrical chamber (101) within which the plunger (105) is sealingly slidable, a needle-carrying hub (120) for automatic retraction into the plunger (105), and a closure (130) for the plunger (105). The closure (130) comprises a member (131) normally in sealing relation with end-adjacent internal provision (133) of the hollow plunger (105) but disengageable therefrom and bodily movable into the hollow plunger (105) by localised first engagement (135) of the member (131) at or near end of contents expression stroke of the plunger (105).

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TITLE : HOLLOW-NEEDLE DEVICES

DESCRIPTION

FIELD OF INVENTION

5 This invention relates to hollow-needle devices such as hypodermic syringes and body fluid samplers; and has particular relevance to such devices with provision for automatic full retraction of the hollow-needle after use for device contents expression, usually after a single such use.

10 BACKGROUND TO INVENTION

Our PCT Application No. GB92/00652 concerns such devices where needle retraction involves entry of a needle-carrying hub into hollow interior of a plunger capable of serving for device contents expression through the needle. 15 During such contents expression, of course, the plunger needs its end later to receive the needle-carrying hub to be closed off and in sealed relation to the contents being expressed, but in a manner that can and will reliably be so disrupted after contents expression as to permit desired retraction of needle and hub parts into the hollow interior 20 of the plunger. A disruptable closure, such as a piercable or frangible membrane as a seal across the end of the plunger is technically feasible, including as to being disrupted as required at and for needle retraction, 25 typically by sharp projections from the needle-carrying hub itself. However, difficulties can arise in terms of

achieving all desiderata, particularly for an intendedly single-use, i.e. disposable, hollow-needle device.

Specifically, for what must be a high volume product made using high speed moulding and automatic assembly of its parts at low finished cost, there are problems for consistently and reliably achieving required full sealing indefinitely and full disruption always allowing required free passage of parts. These requirements become yet more difficult to meet when allied with seeking to provide that fully effective disruption of the end closure of the plunger be achieved with no or low preferably un-noticably insignificant increase in required force applied to the plunger compared with that used for contents expression. A displaceable sliding plug will normally fail at least in such respect.

It is an object of this invention to provide plunger closure means with better capability to meet desiderata for an automatically retractable hollow-needle device.

#### SUMMARY OF INVENTION

According to one aspect of this invention, there is provided a hollow needle device comprising a hollow plunger, a body part affording a cylindrical chamber within which the plunger is sealingly slidable, a needle-carrying hub for automatic retraction into the plunger, and a closure for the plunger, the closure comprising a member normally in sealing relation with end-adjacent internal provision of the hollow plunger but disengageable therefrom and bodily movable into the hollow plunger by localised first engagement of the member at or near end of contents expression stroke of the plunger.

The sealing relation may be peripheral of the closure member and the localised displacing engagement may be eccentric within such periphery, at least for a stiff said closure member that is substantially undeformed in being dislodged in a manner involving tipping first movement.

The needle-carrying hub may itself make direct displacing engagement with the closure member and either or both of the hub and the member may have provision to assure asymmetry of that engagement at the end of said contents-expression stroke of the plunger in the body part.

For a typical hollow-needle syringe-type device of substantially circular cylindrical structure, the closure member can be a flat disc of less diameter than interior of the plunger and having a peripheral groove within thickness of its edge to fit to an internal circumferential rib adjacent the mouth of the plunger. Alternatives for the closure member include anything other than flat that nonetheless presents an annular groove to fit to said rib and otherwise permits easy clearance passage of the closure member along interior of the plunger away from its mouth.

Typical engagement provisions for the needle-carrying hub and the closure member include a localised protrusion from the hub at a position eccentric of the closure member, say as a peg or tooth provision that may be of integrally moulded nature. The opposite is equally feasible, i.e. localised eccentric protrusion from the closure member, or some combination; as is use of any desired intermediate member carrying either or both such localised protrusion(s).

It will be recognised that above substantially flat edge-grooved closure member is a particular application of so-called "tippable discs", a class of devices long known as capable when suitably edge-supported of resisting substantially uniformly applied force much greater than an asymmetrically applied tipping displacement force sufficient to disturb the disc from its edge-support. Given that syringe-type devices hereof normally express contents of liquid form, thus inevitably involve uniform fluid pressures, there is a near-ideal context for application of tippable discs. However, there is well over a decade of

highly numerous proposals for automatic needle retraction in syringe-type devices and none to date have made this connection and so-applied tippable discs. The force discrepancy, namely much lower for dislodgement than is readily withstood applied evenly, is of profound significance to syringe-type hollow-needle devices intendedly for one use only. Human tactile capabilities are extremely sensitive, and trainable by experience. Almost any increase in force required to achieve retraction would become detectable, even if very slight, and so facilitate defeating the objective of limitation to single use; but such action actually well below necessarily applied contents expression forces will not be detectable in that way.

Moreover, the force discrepancy affords a margin of manufacturing tolerance without risk of failure to retraction operation that is exceptionally valuable for making low cost devices and parts thereof.

#### BRIEF DESCRIPTION OF DRAWINGS

Specific exemplary implementation for this invention is now described and shown in the accompanying drawing, in which

Figure 1 is a longitudinal axial sectional view through a syringe-type hollow-needle device 100 with plunger end-sealing as taught herein;

Figure 2 is a cross section at X-X of Figure 1;

Figure 3 is an exploded scrap sectional view showing detail of parts involved in plunger end sealing and unsealing; and

Figures 4A, B and C are similar views showing such parts during contents expression, approaching end thereof, and during automatic needle retraction, respectively.

#### ILLUSTRATED EMBODIMENT

Referring first to Figures 1 and 2, the hollow-needle

syringe-type device 100 has an advantageously one-piece moulded outer body part of elongate hollow conveniently circular cylindrical form that presents a main chamber 101 within which a hollow plunger 105 is sealingly slidable, a forward or extension chamber 110 to a hollow-needle exit nose 111 and housing a retraction spring 112; and internal deflectable arm-type latching formations 115 to hold a needle-carrying hub 120 until released by deflection for needle retraction when engaged by end 106 of the plunger 105. The device 100 is generally as disclosed in published PCT patent specification No WO 92/18187, including convenient outer body part steppings shown at 113 from the main chamber 101 to the forward or extension chamber 110 and at 114 from the latter to the nose 111, and end grip flanging 107 to cooperate with end flanging 108 of the plunger 105.

Inner end formation of the plunger 105 includes outer peripheral bead 105B that can usefully make a direct sliding seal in compressive engagement by interior of the main chamber 101, and is end-tapered at 105T to cooperate with end-tapering 115T to inward latching teeth 116 at ends of the deflectable arms 115. The arms 115 are shown extending from tapered stepping 113 in localised accommodations 117 between reductions 118 of the outer body part, and the teeth 116 capture head 120H of top-hat or T-section needle-carrying hub 120 with retraction spring 112 held retracted about stem 120S of the hub 120. Engagement of the end-tapering 105T of the plunger 105 with end-tapering 115T of the arms 115 deflects the arms 115 into sufficient spacing 117S in accommodations 117 to release the hub 120 for retraction forced by the spring 112 through end seal 130 of the hollow plunger 105 into its interior 109 complete with needle 121 in fixed relation with through-bore 122 of the hub 120. The plunger 105 is preferably latched when fully entrant the outer body part, see

cooperating rib and groove formations 123, 124.

The plunger end seal 130 is of tippable disc type, see further in Figures 3 and 4. Specifically, as shown, a circular disc 131 has a peripheral edge groove 132 within its thickness, and the hollow plunger 105 has a cooperating inner end-adjacent rib 133. This rib 133 is of readily bump-off nature thus not adversely affecting one-piece mouldability of the plunger 105. The disc 131 is of slightly less overall diameter than interior 109 of the hollow plunger 105 to move freely in such interior 109 as and when required. Snap-action insertion of the disc 131 into all-round engagement of its groove 132 on the plunger rib 133 is readily achieved in high-speed assembly equipment.

Liquid-tight sealing between the disc 131 and the plunger 105 is aided by assuring that mould tooling for the disc 131 has a split line close to a main face of the disc 131 rather than in the groove 132, preferably substantially clear of such groove; and by some degree of compression of the plunger 105 by walling of the main chamber 101 of the outer body part. Suitable materials for the outer body part, the plunger 105 and the disc 131 are stiff nucleated homopolymer polyethylene, less stiff high density polyethylene, and lower density polyolefin typically polypropylene or polyethylene, respectively.

The disc 131 as peripherally located and held by its groove 132 cooperating with the plunger rib 133 will resist much larger evenly applied force (as by fluid pressure as the plunger 105 expresses contents of the main chamber 101 through the needle 121) than an eccentrically applied force sufficient to dislodge the disc 131 from such location. Accordingly, head 120H of the needle-carrying hub 120 has a protruding peg formation 135 near its edge to engage the disc 131 asymmetrically and dislodge it into the interior 109 of the plunger 105 at the end of a contents expression stroke of the plunger 105.

## CLAIMS

1. Hollow-needle device comprising a hollow plunger, a body part affording a cylindrical chamber within which the plunger is sealingly slidable, a needle-carrying hub for automatic retraction into the plunger, and a closure for the plunger, the closure comprising a member normally in sealing relation with end-adjacent internal provision of the hollow plunger but disengageable therefrom and bodily movable into the hollow plunger by localised first engagement of the member at or near end of contents expression stroke of the plunger.
2. Hollow-needle device according to claim 1, wherein the closure member has peripheral said sealing relation.
3. Hollow-needle device according to claim 2, wherein said sealing relation is aided by the plunger being to some degree compressed by the body part.
4. Hollow-needle device according to claim 2 or claim 3, wherein the closure member has said localised displacing engagement eccentric within its periphery.
5. Hollow-needle device according to claim 2, 3 or 4, wherein the closure member is stiff and substantially undeformed in being dislodged in a manner involving tipping first movement.
6. Hollow-needle device according to any preceding claim, wherein the closure member presents an annular groove to fit to an internal circumferential rib adjacent the mouth of the plunger, and is otherwise an easy clearance passage along interior of the plunger away from its mouth.
7. Hollow-needle device according to claim 6, wherein the closure member is a moulding and has a mould parts split line substantially clear of its said annular groove.
8. Hollow-needle device according to claim 6 or claim 7, wherein the closure member is a flat disc of less diameter than interior of the plunger beyond said rib.
9. Hollow-needle device according to any preceding claim,



wherein the needle-carrying hub itself serves to make direct displacing engagement with the closure member.

5 10. Hollow-needle device according to claim 9, wherein the the hub and/or the closure member has provision to assure asymmetry of said displacing engagement at the end of said contents-expression stroke of the plunger in the body part.

10 11. Hollow-needle device according to claim 10, wherein said engagement provision for the needle-carrying hub and the closure member includes a localised protrusion at a position eccentric of the closure member.

12. Hollow-needle device according to claim 11, wherein said localised protrusion is integral with said hub and/or said closure member.

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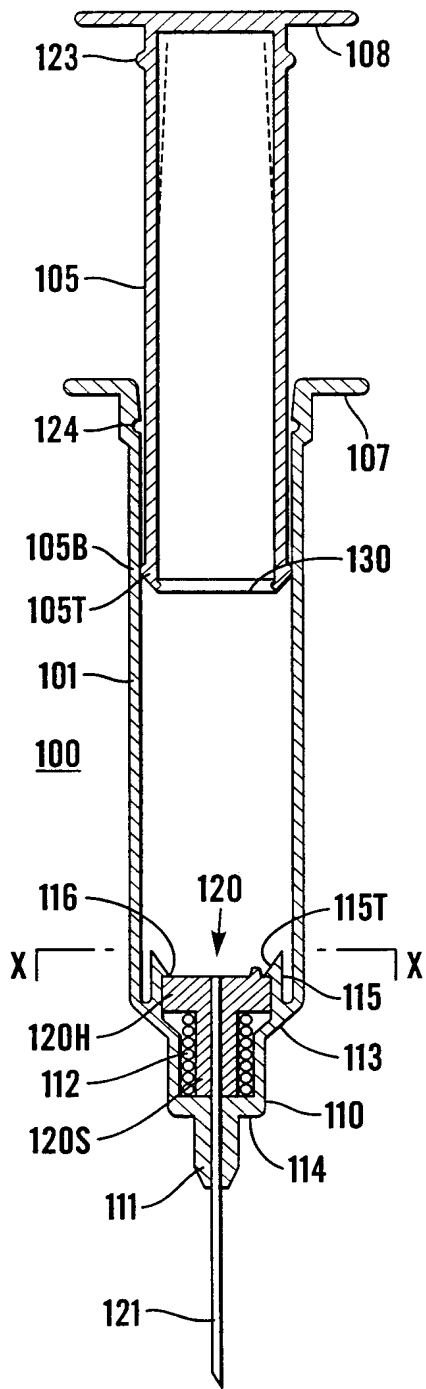


Fig. 1

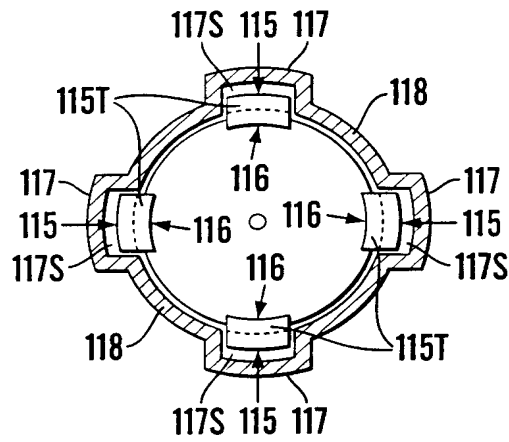


Fig. 2

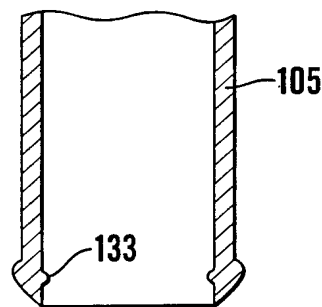


Fig. 3

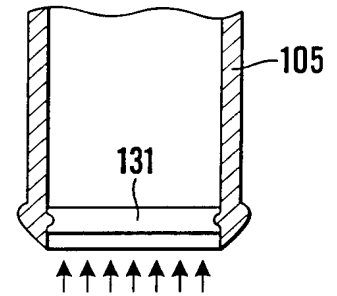


Fig. 4A

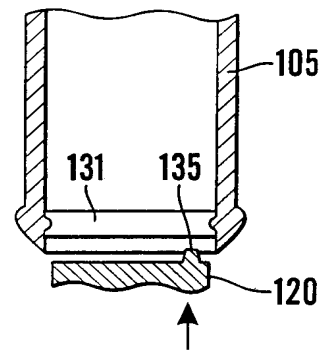


Fig. 4B

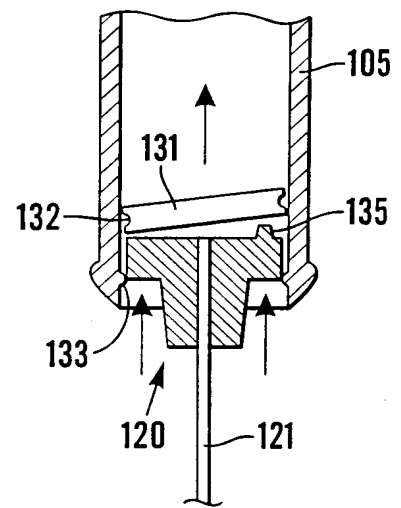


Fig. 4C